

## Austenitic Stainless Steel

# Aperam 304LN – 304N

### Chemical Composition

| Elements (%) | C     | Si  | Mn  | Cr   | Ni  | N    |
|--------------|-------|-----|-----|------|-----|------|
| 304LN/304N   | 0.025 | 0.3 | 1.9 | 18.2 | 8.6 | 0.15 |

Typical values.

| Grade designation | European designation                         | American designation                  |
|-------------------|--|---------------------------------------|
| 304LN             | X2CrNiN18-10 / Type 1.4311 <sup>(1)(2)</sup> | S30453 / Type 304LN <sup>(3)(4)</sup> |
| 304N              | X5CrNiN19-9 / Type 1.4315 <sup>(1)</sup>     | S30451 / Type 304N <sup>(3)(4)</sup>  |

<sup>(1)</sup> According EN 10028-7 | <sup>(2)</sup> According EN 10088-2

<sup>(3)</sup> According ASTM A240 | <sup>(4)</sup> According ASME SA-240

These grades comply with:

- > Aperam Stainless Europe - Safety Information Sheet for Stainless Steel
- > European Directive 2000/53/EC on end-of-life vehicles and later modifications
- > NFA 36 711 standard on stainless steel intended for use in contact with foodstuffs, products and beverages for human and animal consumption (non-packaging steel)
- > Requirements of NSF/ANSI 51-2009 edition on International Standard for Food Equipment Materials and of FDA (United States Food and Drug Administration) requirements regarding materials used for food contact
- > French regulatory paper dated 13 January 1976 relating to materials and articles made of stainless steel in contact with foodstuffs
- > PED (Pressure Equipment Directive), according to 2014/68/EU
- > French Decree No. 92-631 dated 8 July 1992 and Regulation No. 1935/2004 of the European Parliament and the Council of 27 October 2004 on materials and articles intended to come into contact with food (and repealing Directives 80/590/EEC and 89/109/EEC)
- > Regulation No. 1935/2004 of the European Parliament and the Council of 27 October 2004 on materials and articles intended to come into contact with food (and repealing Directives 80/590/EEC and 9/109/EEC)
- > CPR (Construction Products Regulation) according to 305/211/EU

### Key Features

- > High mechanical properties that are easily enhanced by work hardening, enable notable weight savings in most structural and pressure applications
- > EN 13530-2 and EN 13458-2 certified for pressure strengthening of cryogenic vessels
- > Low carbon content offers excellent intergranular corrosion resistance, including after welding
- > High ductility, strength and toughness at cryogenic temperatures
- > Good resistance to uniform corrosion

### Applications

- > Rail, road and stationary vacuum insulated pressure vessels
- > Cryogenic tanks, storage vessels and piping
- > Lightweight welded tanks and structures (incl. at sub-zero temperatures)
- > Mechanical and structural components

### Product Range

|                | Coils & Sheets    |
|----------------|-------------------|
| Thickness (mm) | 1 up to 13        |
| Width (mm)     | Up to 2000 mm     |
| Finish         | 1D / 2B / 2E / 2H |

## Physical Properties

### Cold rolled and annealed sheet

|                                    |   |                      |          |      |
|------------------------------------|---|----------------------|----------|------|
| Density                            | d | kg/dm <sup>3</sup>   | 20°C     | 7.9  |
| Specific heat                      | c | J/kg.K               | 20°C     | 500  |
| Thermal conductivity               | k | W/m.K                | 20°C     | 15   |
| Mean thermal expansion coefficient | α | 10 <sup>-6</sup> /K  | 20-100°C | 16.0 |
|                                    |   |                      | 20-300°C | 17.0 |
|                                    |   |                      | 20-500°C | 18.0 |
| Young's modulus                    | E | GPa                  | 20°C     | 200  |
|                                    |   |                      | 300°C    | 179  |
|                                    |   |                      | 500°C    | 165  |
| Electric resistivity               | ρ | Ω mm <sup>2</sup> /m | 20°C     | 0.73 |

## Mechanical Properties

### Test piece

Length = 50 mm (thickness < 3 mm)  
 Length = 5.65 √ S<sub>0</sub> (thickness ≥ 3 mm)  
 Cold rolled

### In the annealed condition

In accordance with ISO 6892-1, part 1  
 Test piece perpendicular to rolling direction

| Grades            | European designation | ASTM A240         | R <sub>m</sub> <sup>(1)</sup> (MPa) | R <sub>p0.2</sub> <sup>(2)</sup> (MPa) | A <sup>(3)</sup> % |
|-------------------|----------------------|-------------------|-------------------------------------|--|--------------------|
| 301LN             | 1.4318               | 301LN             | 760                                 | 350                                    | 48                 |
| 304L              | 1.4307               | 304L              | 630                                 | 310                                    | 54                 |
| 201LN             | 1.4371               | 201LN             | 720                                 | 360                                    | 55                 |
| <b>304LN/304N</b> | <b>1.4311/1.4315</b> | <b>304LN/304N</b> | <b>660</b>                          | <b>350</b>                             | <b>48</b>          |

1 MPa = 1 N/mm<sup>2</sup> - Typical values

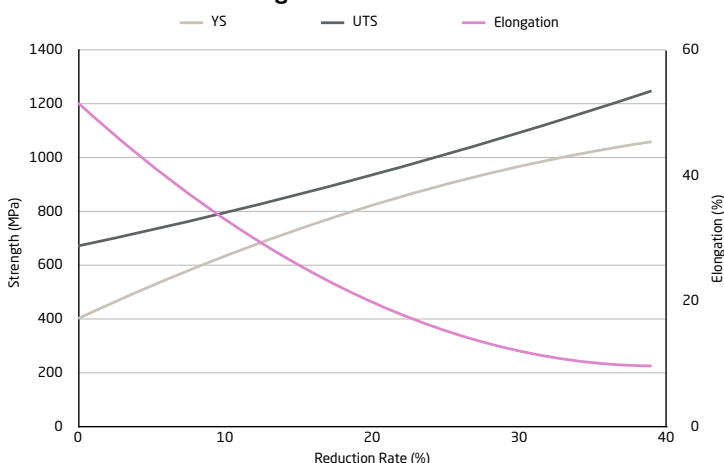
<sup>(1)</sup> Ultimate Tensile Strength (UTS) - <sup>(2)</sup> Yield Strength (YS) - <sup>(3)</sup> Elongation (A)

### Cryogenic tensile properties (Typical values)

Reference data from EN 10028-7

| Temp(°C) | 304LN/304N (annealed) |                         |       | 304L (annealed)      |                         |       |
|----------|-----------------------|-------------------------|-------|----------------------|-------------------------|-------|
|          | R <sub>m</sub> (Mpa)  | R <sub>p0.2</sub> (MPa) | A (%) | R <sub>m</sub> (Mpa) | R <sub>p0.2</sub> (MPa) | A (%) |
| 20       | 550                   | 270                     | 40    | 500                  | 200                     | 45    |
| -80      | 850                   | 350                     | 40    | 830                  | 220                     | 35    |
| -196     | 1250                  | 550                     | 35    | 1200                 | 300                     | 30    |

### Effect of work-hardening



### Impact toughness

Average value in J/cm<sup>2</sup> for 5 mm thickness corresponds to EN 10088-2 specification. The toughness of our 304LN grade is 200 J/cm<sup>2</sup> at -196 °C and 270 J/cm<sup>2</sup> at -60 °C. The minimum lateral expansion of our 304LN grade is 0.8 mm over the entire temperature range from 20°C to -196°C.

## Corrosion Resistance

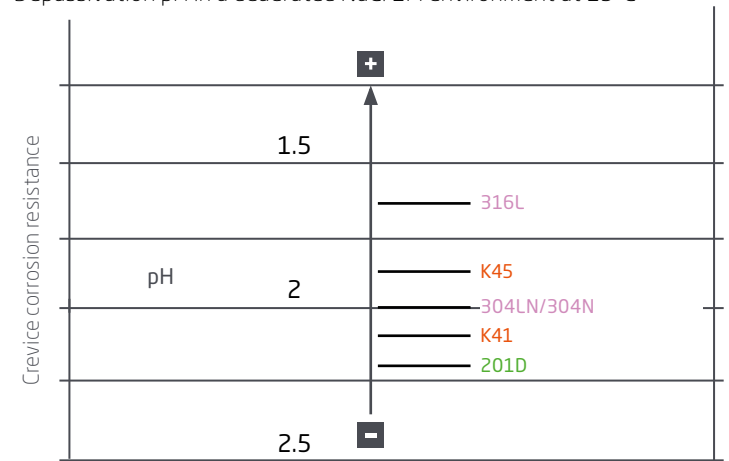
Our 304LN/304N grade has good general resistance to wet corrosion and is especially recommended when there is a risk of intergranular corrosion. The grade also has a good resistance to various acids.

### Crevice corrosion

Crevice corrosion occurs in two stages. During the first stage (initiation), chloride accumulates and acidification begins. This eventually causes depassivation within the crevice region. A depassivation pH is the critical condition for passivity breakdown.

The metal begins to dissolve during the second stage (propagation). This process can be slowed down using grades that contain molybdenum and nickel as both elements are known to decrease the speed of propagation.

Depassivation pH in a deaerated NaCl 2M environment at 23°C



### Intergranular corrosion

Our 304LN/304N grade is especially recommended when there is a risk of intergranular corrosion. It meets the requirements of the standard tests defined by ISO 3651-2 (sensitizing treatments T1 and T2).

## Forming

In the annealed condition, our 304LN/304N grade can be readily cold formed using all standard processes, including bending, profiling, drawing, deep drawing, roll-forming, spinning, etc.

Due to its elevated mechanical properties and the fact that its nitrogen content means it can be hardened by cold-forming operations, our 304LN/304N grade requires larger forming efforts. It also induces a springback effect.

## Welding

Our 304LN/304N grade is designed for welding applications. No heat treatment is necessary after welding. To fully restore the corrosion resistance of the metal, the welds must be mechanically or chemically descaled and then passivated and decontaminated. However, depending on the application, this operation may be not essential.

Welding 304LN/304N is very comparable to welding 304L. For standard applications, we suggest following the table below. In applications where temperatures move below -200°C or higher mechanical properties apply, standard procedures might not be advisable. In this case, please consult us for additional technical support.

| Welding process        | No filler material<br>Typical thicknesses | With filler metal<br>Thicknesses | With filler metal      |                          | Shielding gas  |
|------------------------|---|----------------------------------|------------------------|--------------------------|--|
|                        |   |                                  | Filler material        |                          |  |
|                        |   |                                  | Rod                    | Wire                     |  |
| Resistance: Spot, Seam | < 2 mm                                    |                                  |                        |                          |  |
| TIG/GTAW               | < 1.5 mm                                  | > 0.5 mm                         | ER 308L <sup>(1)</sup> | ER 308L <sup>(1)</sup>   | Top side: Ar<br>Back side: N <sub>2</sub> or Ar                                  |
| Plasma                 | < 1.5 mm                                  | > 0.5 mm                         |                        | ER 308L <sup>(1)</sup>   | Top side: Ar<br>Back side: N <sub>2</sub> or Ar                                  |
| MIG/GMAW               |   | > 0.8 mm                         |                        | ER 308LSi <sup>(1)</sup> | Top side: Ar+1.5%/2%O <sub>2</sub> or Ar+2%CO<br>Back side: N <sub>2</sub> or Ar |
| SAW                    |   | > 2mm                            |                        | ER 308L <sup>(1)</sup>   |  |
| SMAW                   |   | Repairs                          | ER 308L <sup>(1)</sup> |                          |  |
| Laser                  | < 5 mm                                    |                                  |                        |                          | N <sub>2</sub> or Ar or He   |

<sup>(1)</sup> AWS A5.9

## Heat Treatment and Finishing

### Annealing

After cold forming (work hardening) and welding, using an annealing treatment for a couple of minutes at 1,050°C ±25°C, followed by air cooling or water quenching, restores the microstructure (recrystallisation and dissolution of carbides) and eliminates internal stresses. After annealing, pickling, followed by passivation, is necessary.

### Pickling

- > Nitric-Hydrofluoric acid mixture (10% HNO<sub>3</sub> + 2% HF) at ambient temperature or up to 60°C
- > Sulfuric-Nitric acid mixture (10% H<sub>2</sub>SO<sub>4</sub> + 0.5% HNO<sub>3</sub>) at 60°C
- > Use descaling pastes for weld areas

### Passivation

- > 20-25% HNO<sub>3</sub> solution (36° Baumé) at 20°C
- > Use passivating pastes for weld zones

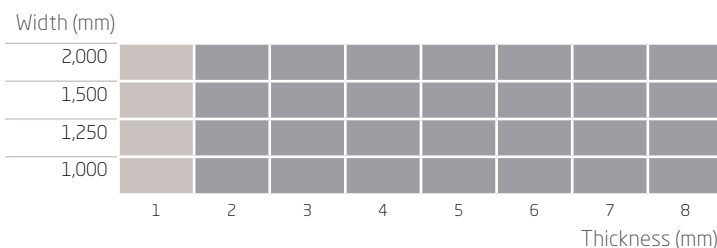
### Polishing

The surface of our 304LN/304N is suitable for all kinds of polishing (grit, scotch-brite, electro polishing).

## Size Range

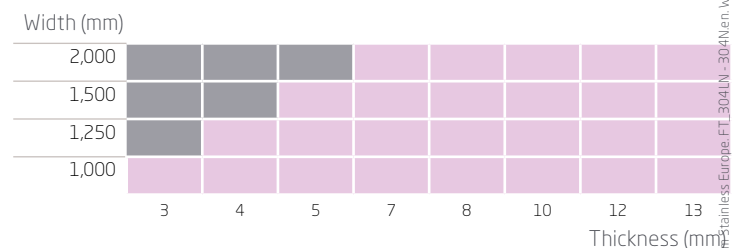
Our size range is based on our production capabilities. For the latest information per grades on our offer, please contact us.

### Cold Rolled



■ 2D - 2B - (2H) ■ 2D - 2D: please consult

### Hot Rolled and HRC



■ Hot rolled HRAP - 1D ■ Cold rolled HRC - 2E



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